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Three New Species of the Spider Genus *Liphistius* (Araneae, Mesothelae) from Malaysia

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ABSTRACT

Three new species of the spider genus *Liphistius* Schiödte are described from peninsular Malaysia: *L. laruticus* (male and female) from a mountain, and *L. kanthan* (female) and *L. tempurung* (female) from caves; notes are provided on their natural history. Although the two cave species were collected from sites only 39 km

apart, they are not closely related; both *L. laruticus* and *L. kanthan* belong to the *trang*-group of species from Thailand and northern Malaysia, whereas *L. tempurung* appears to be closer to central and southern Malaysian species. Two records of *L. desultor* Schiödte from the mainland are confirmed on the basis of newly collected males.

INTRODUCTION

Spiders of the genus *Liphistius* Schiödte have been recognized as "living fossils" since their first discovery over a century and a half ago. When the genus was revised by Platnick and Sedgwick (1984), only five classical and nine newly described species were recognized, restricted to eastern Burma, Thailand, Malaysia, and Sumatra. Since then,

numerous new taxa and descriptions have been provided by Ono (1988a, 1988b), Ono and Schwendinger (1990), Schwendinger (1987, 1990, 1995, 1996, in press), Sedgwick and Platnick (1986, 1987), and Sedgwick and Schwendinger (1990). Most of the additional species are from Thailand.

Recent collecting in peninsular Malaysia

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by H. Steiner and P. Schwendinger uncovered new *Liphistius* species and provided new information on two mainland records of *L. desultor* Schiödte, a species originally described from Penang Island. Those identifications of *L. desultor* (by Platnick and Sedgwick, 1984: 20), based on female specimens only, were questioned by Schwendinger (1995: 155) because of the considerable variation observed in the shape of female genitalia in species from Thailand. However, males newly collected from both localities indicate that the original assignments were correct.

In the present paper, we describe three new species, including two collected in caves near Ipoh in northern Malaysia. The two cave species join five others that are known only from caves and their entrances (Sedgwick and Schwendinger, 1990) and show varying degrees of adaptation to cave life. The two new species show only slight reduction in the size of the anterior median eyes, and it would not be surprising to find that each one also occurs on the mountainsides in which the caves are situated.

We thank Barbara Thaler-Knolach for help in rearing specimens, M. U. Shadab for assistance with illustrations, and Fred Coyle, John Murphy, Robert Raven, and Walter Sedgwick for helpful comments on a draft of the manuscript. All specimens are deposited in the American Museum of Natural History (AMNH) or the Muséum d'Histoire Naturelle, Geneva (MHNG). The standard abbreviations of morphological terms follow those of Platnick and Sedgwick (1984); all body measurements are in millimeters.

NATURAL HISTORY OF THE CAVE SPECIES

GU TEMPURUNG

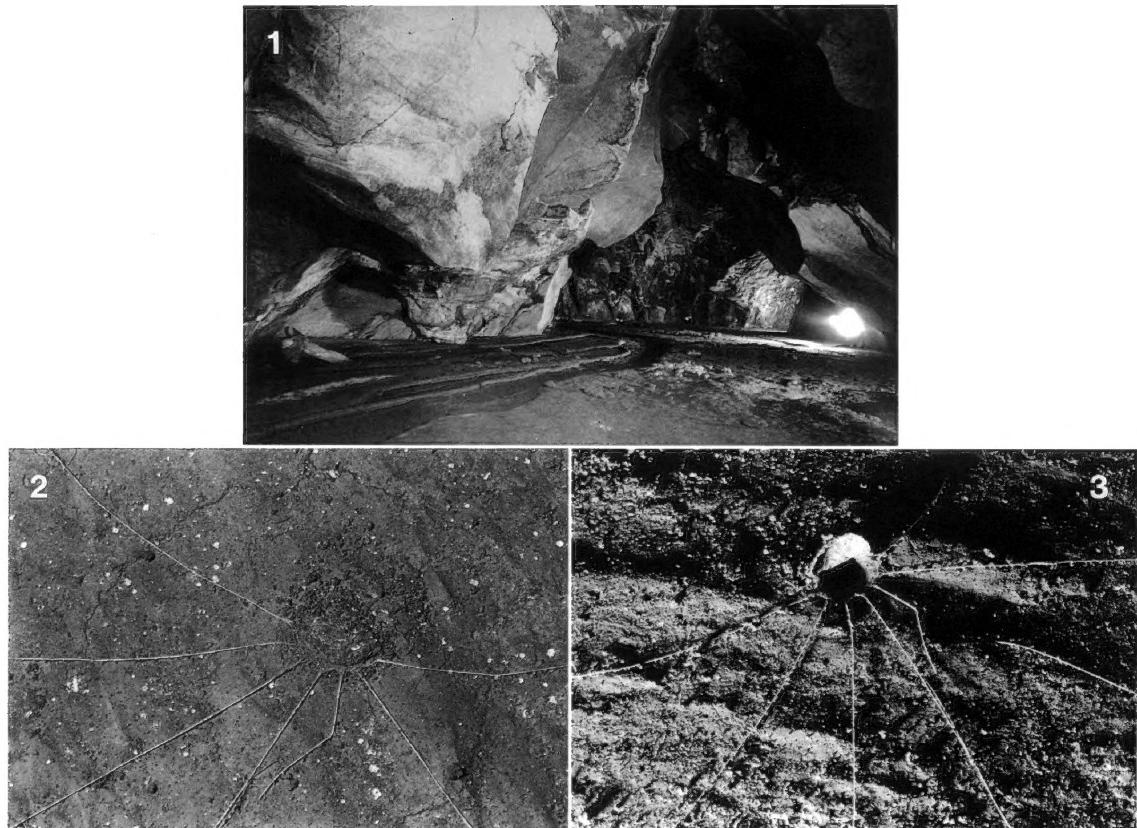
Gua Tempurung is a 3.4 km long tunnel cave in the Marble Hills of the Kinta Valley near Ipoh in Perak, Malaysia, with its entrance situated at 4°24.986'N, 101°11.212'E. The liphistiids in Gua Tempurung were first noted by Gebauer (1993: 89), who attributed the specimens to *Liphistius batuensis* Abraham, a species that is known only from the Batu Caves and the nearby Gua Anak Takun in Templar Park, north of Kuala Lumpur in

Selangor, Malaysia, about 200 km to the south. Members of the Malaysian Nature Society's Cave Group, especially Gary Lim and Lim Swee Yian, were able to confirm the presence of *Liphistius* in Gua Tempurung, and Mr. Gebauer was kind enough to provide details on the places in the cave where he had seen the spiders.

On May 18, 1996, the third author visited the site and (despite having little time available) succeeded in finding a female *Liphistius*. A detailed account of the cave and surrounding area has been provided by Gebauer and Price (1995). Set in Gunung Tempurung, which at 612 m is one of the highest limestone peaks on the Malaysian Peninsula, the cave is generally straight, with few side passages, and includes 1.6 km of river passage. Despite human disturbance (tin mining early in this century and use as a Communist hide-out prior to 1960), the fauna is still rich (especially in the unflooded upper chambers). The arthropod fauna includes cockroaches, cave crickets, scutigerid centipedes, scorpions, amblypygids, and araneomorph spiders, living in an ecosystem founded on guano deposits from the resident bats.

The specimen was found in a wind tunnel leading from the "Top of the World" chamber to "End of the World" at Gergasi Cavern (figs. 1–3). This tunnel is 6–8 m wide, situated rather high above the river level, with a flat clay floor that is partially covered by a small stream. The *Liphistius* was found in a burrow situated about 2 m from the stream, and only a few cm higher. The burrow was initially vertical but turned and ran parallel to the surface; seen from above, the burrow was s-shaped, about 12 cm long, and 6 cm deep at the end. Cave crickets were in the tunnel and are probably the normal prey items.

During a revisit to the same site in August, 1996, five burrows were found, but all appeared to be abandoned; no nests were found attached to the cave wall. According to Lim Swee Yian, the spiders have also been found within the Gergasi Chamber. The cave is currently being developed for tourism, and Steve Riley (in litt.), an Australian consultant for that development, has reported finding six additional specimens "In Alam Chamber, in undercut areas, on angled/vertical rocks,



Figs. 1–3. Habitat of *Liphistius tempurung*, new species. 1. The wind tunnel leading from the “Top of the World” chamber in Gua Tempurung; the burrow of the holotype was found in the area shown in the lower left corner, photograph by Yee Chun Wah. 2, 3. Burrow entrance and trapdoor, photographs by H. Steiner.

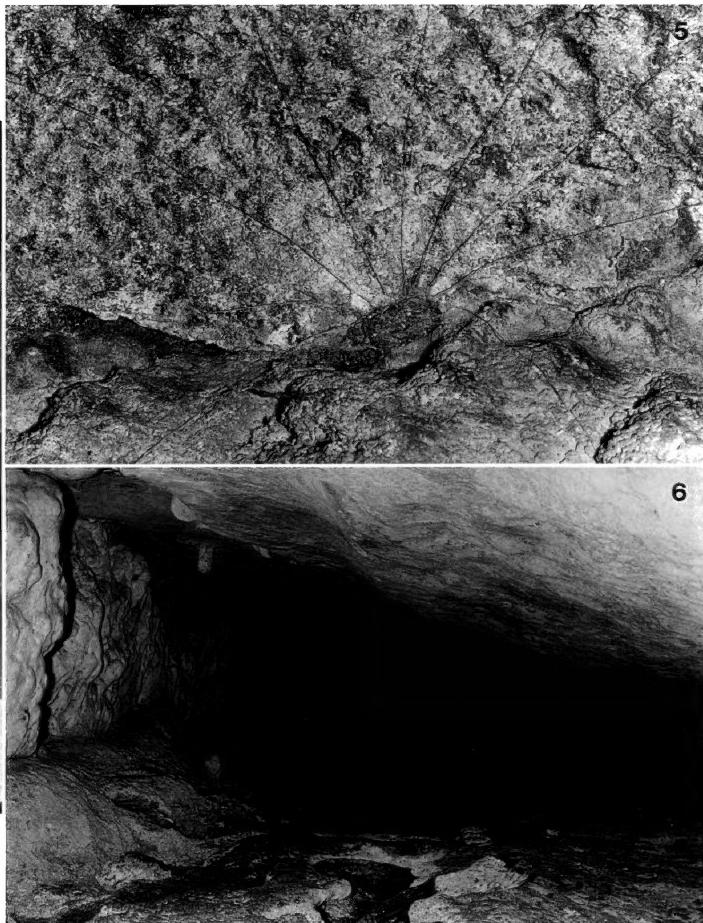
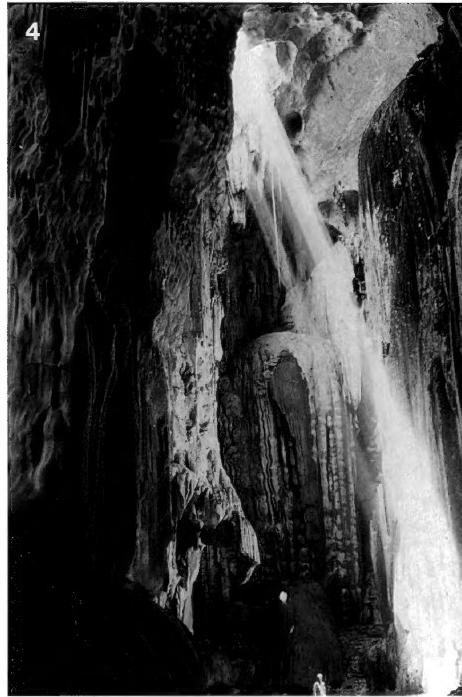
where major bat colonies are, just away from guano” during September and October, 1995.

GUA KANTHAN

This cave is situated in a limestone hill named Gunung Kanthan, 39 km north of Gua Tempurung, at $4^{\circ}45.685'N$, $101^{\circ}07.322'E$. So far as we know, no survey of the cave has been published, but it is roughly 500 m long and 40 m high. A large entrance, rather high up the hill, slopes down into a more constricted passage leading into a large chamber with an opening overhead. The chamber gradually becomes smaller and leads to an exit. A meandering stream has cut into the cave floor, but the water now appears to be stagnant. In this cave, all the *Liphistius* specimens were found in nests on the cave walls, in four places, each 1.5–2.0 m above the floor.

The first site is on the wall of the constricted passage, where it opens into the chamber (fig. 4); seven nests were found in this twilight zone, all built into cracks in the wall. In the large chamber, also in the twilight zone, eight nests were found (fig. 5). One small specimen was taken from a nest built on a small ledge holding clay and guano, with its opening toward the top and seven “fishing lines” (i.e., signal threads), of which the longest reached 14 cm; the trapdoor measured 20×15 mm. Another nest had eight fishing lines, with the longest reaching 20 cm; the trapdoor of that nest measured 23×13 mm. At this site, most of the nests were built between the rock wall and the guano or clay, or in cracks; only one was made of silk attached to the bare wall.

The third site was at the small exit, exposed to full daylight, where one nest was built into a crack of the wall. The most im-



Figs. 4–6. Habitat of *Liphistius kanthan*, new species. 4. Constricted passage in Gua Kanthan, where it opens into the chamber. 5. Entrance of nest found in the large chamber. 6. The small chamber where the largest population was found. Photographs by H. Steiner.

portant site was a permanently dark, small chamber situated under the floor of the large chamber (fig. 6). This room is about 2 m high, with a very wet floor covered with guano from the bats living on the ceiling. The highest point in the chamber is about 1 m above the water level; its dimensions are roughly 4 × 10 m. The walls of this triangular room consist of strongly structured limestone deposits (a secondary formation). Thirty *Liphistius* nests were counted, all on the wall close to the ceiling, with most built into cracks or depressions but a few as silk nests attached to the wall.

Unfortunately, the entire hill has been leased out for quarrying, so the prospects for the future of the spiders may be bleak.

SYSTEMATICS

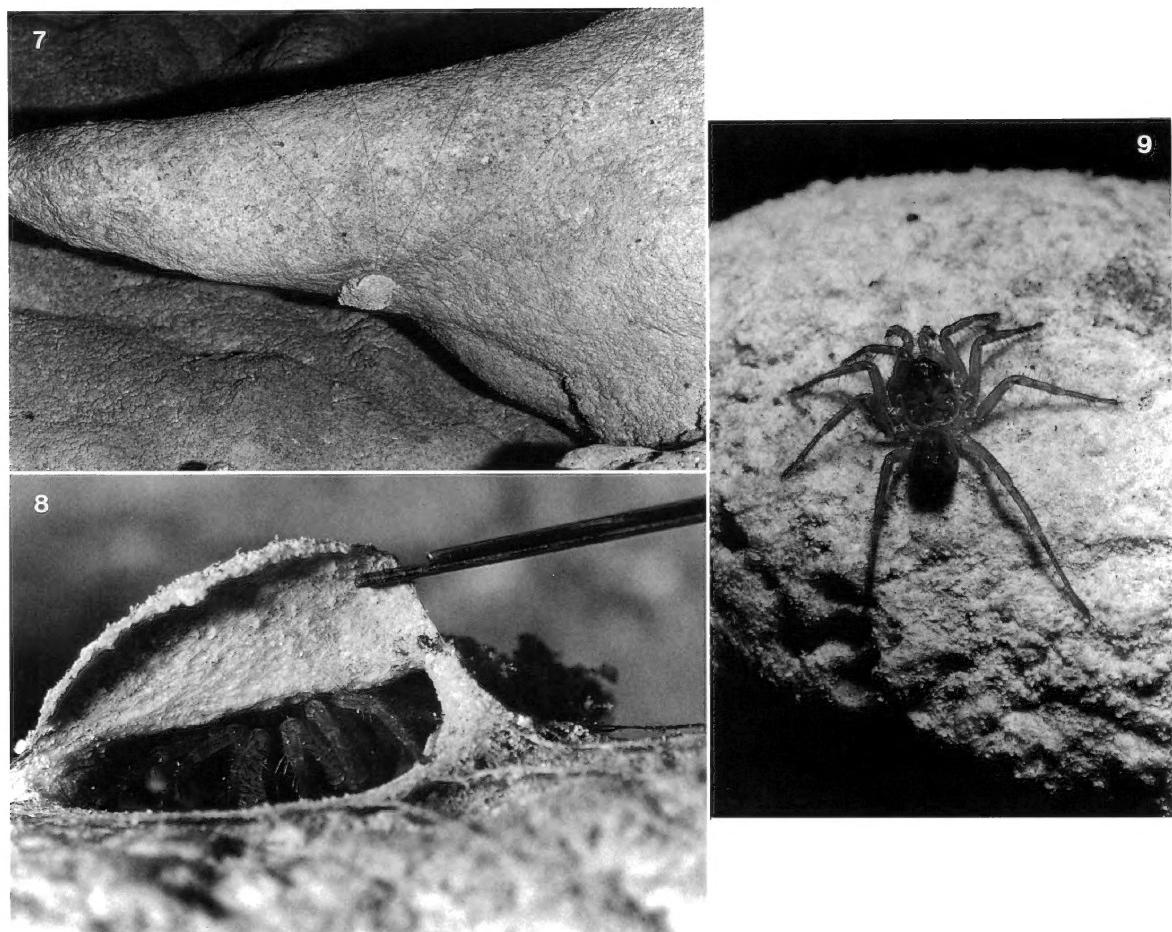
Liphistius tempurung Platnick, new species

Figures 1–3, 10, 11

TYPE: Female holotype from Gua Tempurung, S of Ipoh, Perak, Malaysia, 4°24.986'N, 101°11.212'E (May 18, 1996; H. Steiner), deposited in AMNH.

ETYMOLOGY: The specific name is a noun in apposition taken from the type locality.

DIAGNOSIS: Females of this species resemble those of *L. malayanus* Abraham and *L. johore* Platnick and Sedgwick in having a receptacular cluster that extends anterior of a rectangular poreplate (see Platnick and Sedgwick, 1984: figs. 68, 69, 79, 80). They differ



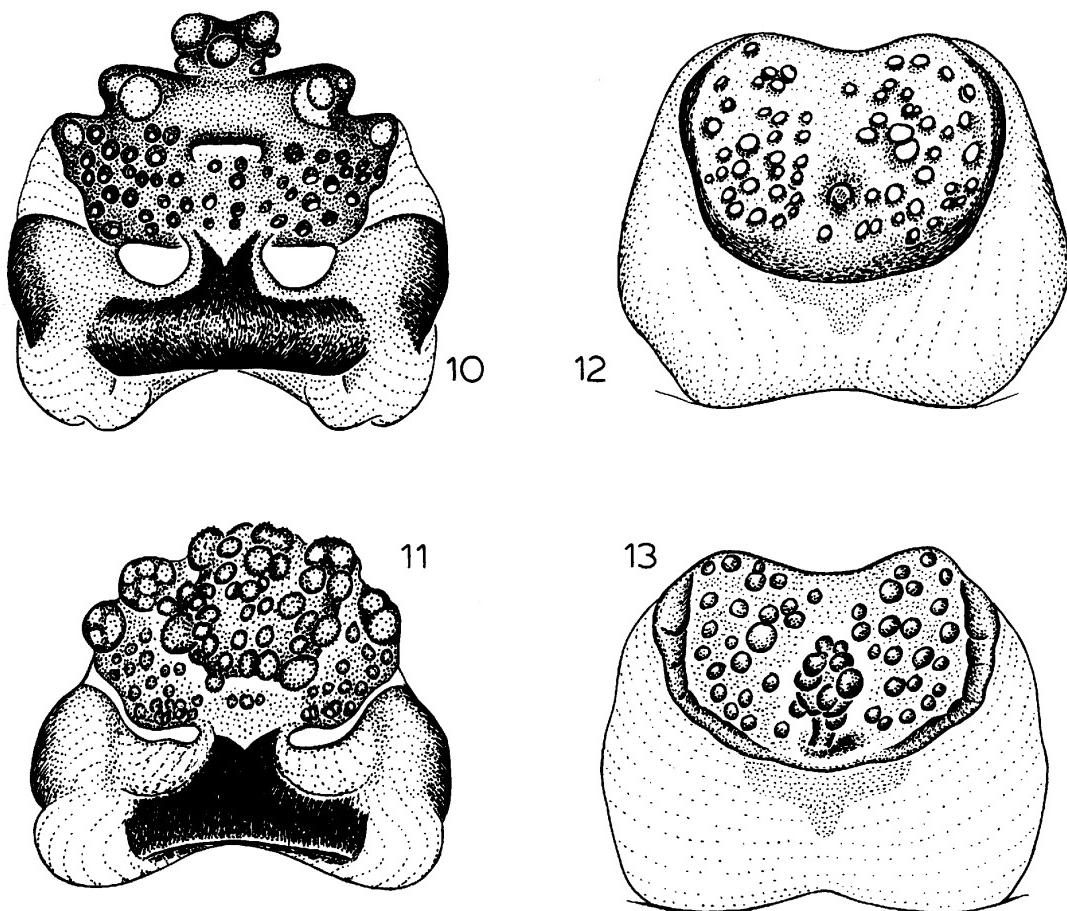
Figs. 7-9. *Liphistius kanthan*, new species. 7, 8. Entrance of the nest of the holotype, from the small chamber of Gua Kanthan. 9. Holotype female. Photographs by H. Steiner.

from those of *L. malayanus* in having incised anterolateral corners on the poreplate, and from those of *L. johore* by the larger posterior stalk (figs. 10, 11).

MALE: Unknown.

FEMALE: Carapace brownish yellow, pars cephalica with pair of paramedian, semicircular paler patches behind ocular tubercle and circular paler patch along midline behind semicircular patches; pars thoracica with paler stripes radiating from thoracic groove to anterior sides of leg coxae; sternum light yellow, slightly darker on steeply sloping margins; chelicerae light yellow proximally, brownish gray anteriorly, brownish yellow posteriorly; abdomen light brown, each tergite with three posterior paler patches, two lateral, one median, sternites

yellow, spinnerets brownish yellow; legs light brownish yellow with darker rings proximally and distally on femora, tibiae, and metatarsi, distally on tarsi. Total length 14.0. Carapace 5.3 long, 4.3 wide. Ocular tubercle 0.51 long, 0.68 wide. Eye sizes and interdistances: AME 0.04, ALE 0.29, PME 0.15, PLE 0.24; AME-AME 0.04, AME-ALE 0.08, PME-PME 0.12, PME-PLE 0.07, ALE-PLE 0.04; MOQ length 0.22, front width 0.11, back width 0.41. Sternum 2.6 long, 1.4 wide. Labium 0.5 long, 1.3 wide. Palpal coxae 2.1 long, 1.1 wide. Cheliceral promargin with 10/11 teeth. Superior tarsal claws with 2-3 teeth restricted to base of long claw, inferior claws with 2-3 tiny denticles; palpal claw with two denticles. Leg and palp measurements:



Figs. 10–13. 10, 11. *Liphistius tempurung*, new species. 12, 13. *L. kanthan*, new species. 10, 12. Female genitalia, dorsal views. 11, 13. Same, ventral views.

	I	II	III	IV	Palp
Femur	3.9	3.8	3.8	5.4	3.4
Patella	2.1	2.0	2.0	2.2	1.7
Tibia	2.7	2.7	2.8	3.8	2.5
Metatarsus	2.4	2.6	3.0	4.9	—
Tarsus	1.2	1.3	1.5	2.4	2.3
Total	12.3	12.4	13.1	18.7	9.9

Abdomen 6.0 long, 4.3 wide. Internal genitalia with wide posterior stalk; poreplate with incised anterolateral corners, receptacular cluster large, protruding anterior of anterior margin of poreplate (figs. 10, 11).

OTHER MATERIAL EXAMINED: None.

DISTRIBUTION: Known only from the type locality.

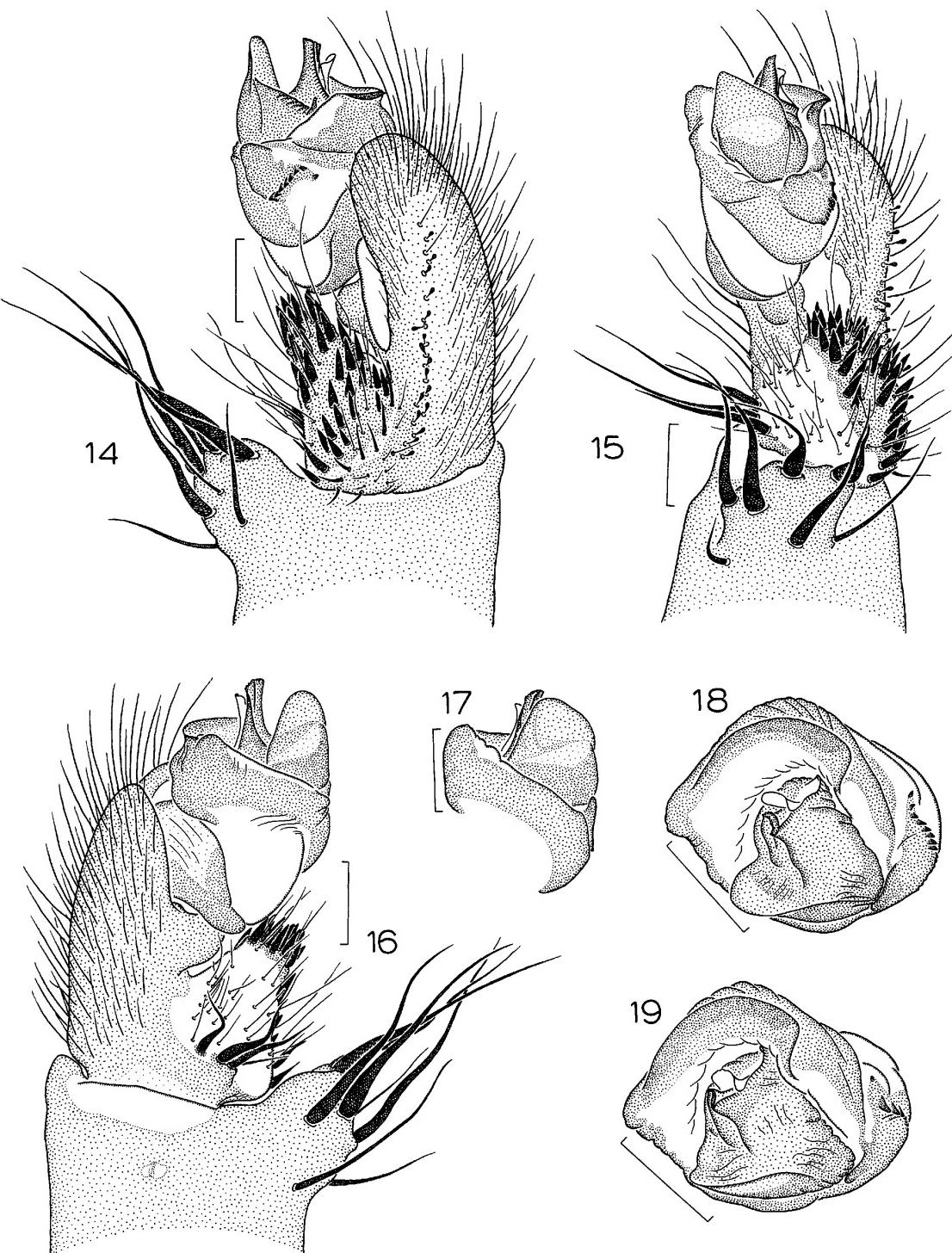
Liphistius kanthan Platnick, new species

Figures 4–9, 12–13

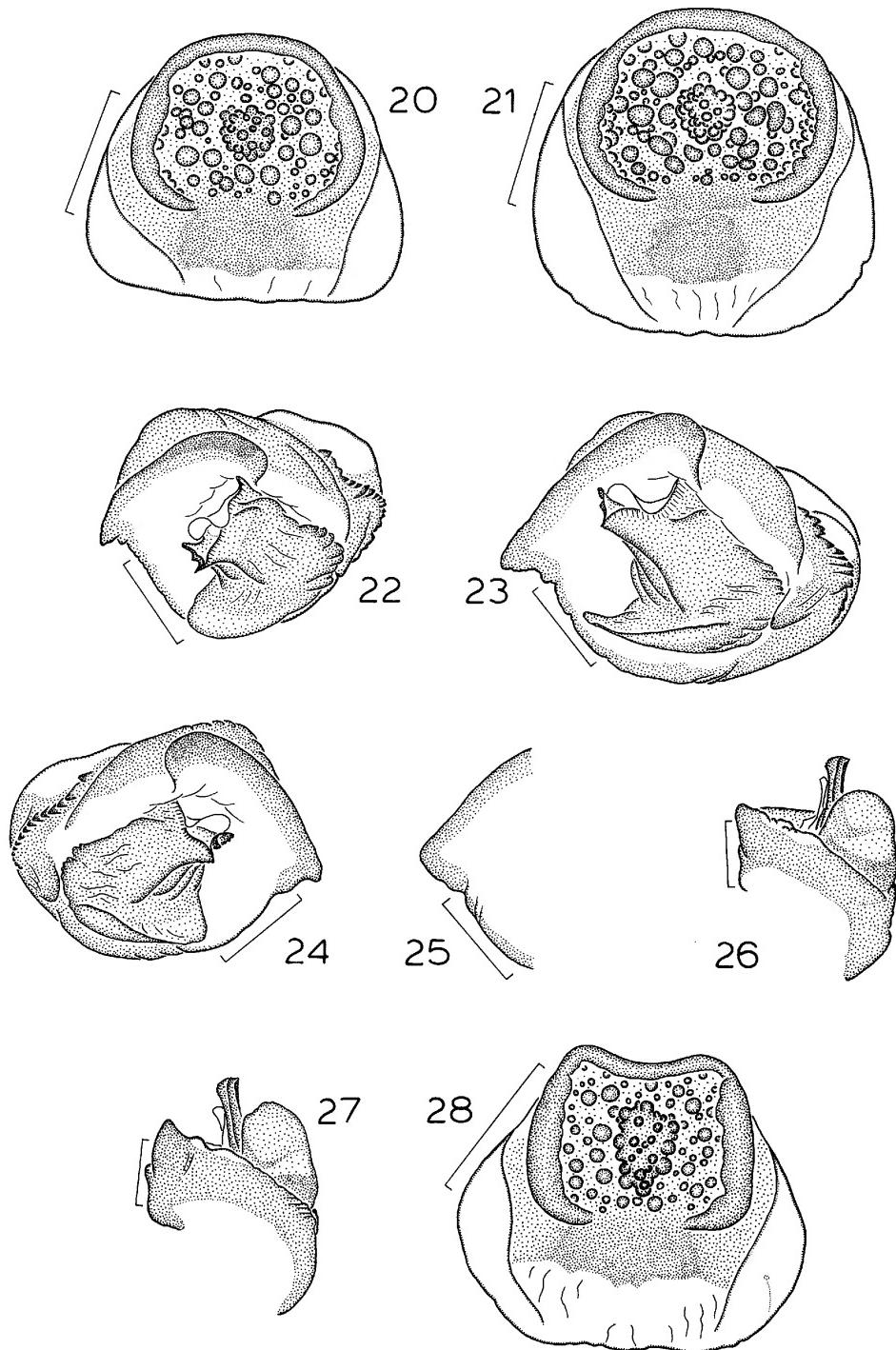
TYPE: Female holotype from Gua Kanthan, N of Ipoh, Perak, Malaysia, 4°45.685'N, 101°07.322'E (Sept. 1996; H. Steiner), deposited in AMNH.

ETYMOLOGY: The specific name is a noun in apposition taken from the type locality.

DIAGNOSIS: This species apparently belongs to the *trang*-group (see Schwendinger, 1990: 349). Within that group, the species will remain difficult to place definitively until the male is discovered. The female resembles that of *L. trang* Platnick and Sedgwick (1984: figs. 20, 21), from southern Thailand, in having lateral thickenings on the ventral surface of the poreplate, but differs in having



Figs. 14–19. *Liphistius lariticus*, new species. **14.** Left palp of male paratype, retrolateral view. **15.** Same, retroventral view. **16.** Same, ventral view. **17.** Distal bulb, ventral view. **18.** Bulb, distal view. **19.** Bulb of holotype, distal view. Scale bars = 0.5 mm.



Figs. 20–28. **20, 21.** *Liphistius laruticus*, new species, vulvae of two females, ventral views. **22–28.** *L. desultor* Schiödte. **22.** Left bulb, distal view, male from Penang Hill. **23.** Same, male from Kedah Peak. **24.** Right bulb, distal view, male from Maxwell Hill. **25.** Tegular process of left bulb, distal view, male from Maxwell Hill. **26.** Left distal bulb, ventral view, male from Maxwell Hill. **27.** Same, male from Kedah Peak. **28.** Vulva of female from Penang Hill, ventral view. Scale bars = 0.5 mm.

an anteromedially invaginated anterior poreplate margin and in the poreplate being wider anteriorly than posteriorly (figs. 12, 13). The female also resembles *L. tham* Sedgwick and Schwendinger (1990, figs. 5, 6), described from a cave in central Thailand, in poreplate shape, but differs in having numerous receptacula on the median invagination, and in having the anterior margin of the poreplate ventrally thin (rather than substantially thickened).

MALE: Unknown.

FEMALE: Carapace pale yellow, pars cephalica with slightly darkened anterior margin and dark, w-shaped marking behind ocular tubercle; pars thoracica with faint darker marking radiating from thoracic groove to posterior sides of leg coxae; sternum light yellow, slightly darker along edge of median flat portion; chelicerae light yellow proximally, brownish gray anteriorly, brownish yellow posteriorly; abdomen light brown, tergites pale, heart visible from above, sternites pale yellow, spinnerets pale brownish yellow; legs light yellow, without darker rings. Total length 10.7. Carapace 4.5 long, 3.9 wide. Ocular tubercle 0.62 long, 0.81 wide. Eye sizes and interdistances: AME 0.04, ALE 0.36, PME 0.22, PLE 0.29; AME-AME 0.04, AME-ALE 0.09, PME-PME 0.07, PME-PLE 0.04, ALE-PLE 0.04; MOQ length 0.29, front width 0.11, back width 0.46. Sternum 2.2 long, 1.6 wide. Labium 0.5 long, 1.1 wide. Palpal coxae 1.5 long, 0.9 wide. Cheliceral promargin with 11/11 teeth. Superior tarsal claws with 3–4 teeth restricted to basal half of claw, inferior claws with 3–4 tiny denticles; palpal claw with 1–2 denticles. Leg and palp measurements:

	I	II	III	IV	Palp
Femur	3.7	3.8	3.7	4.4	3.2
Patella	1.8	1.8	1.6	1.8	1.4
Tibia	2.4	2.6	2.7	3.9	2.4
Metatarsus	2.3	2.6	3.0	4.7	—
Tarsus	1.1	1.2	1.6	2.2	2.2
Total	11.3	12.0	12.6	17.0	9.2

Abdomen 4.5 long, 2.9 wide. Internal genitalia with posteriorly narrowed posterior stalk; poreplate with medially invaginated anterior margin, receptacular cluster narrow,

reaching only to about two-thirds of poreplate length (figs. 12, 13).

OTHER MATERIAL EXAMINED: None.

DISTRIBUTION: Known only from the type locality.

***Liphistius laruticus* Schwendinger, new species**

Figures 14–21

TYPES: Male holotype (collected Jan. 20, 1994, molted on May 12, Sept. 14, 1994, Jan. 20, 1995, matured on Aug. 3, 1995) and female allotype (collected Jan. 20, 1994, molted on May 11, 1994) from an elevation of 1380 m on Maxwell Hill (= Bukit Larut), Perak, Malaysia (P. Schwendinger), deposited in MHNG. Paratypes from the same locality, collected and reared by P. Schwendinger: from elev. 1380 m, 1 male (collected Jan. 20, 1994, molted Apr. 23, 1994, matured Aug. 30, 1994) and from elev. 1150 m, 1 female (collected Feb. 5, 1991, molted Apr. 14, 1991), deposited in AMNH.

ETYMOLOGY: The specific name refers to the type locality.

DIAGNOSIS: This species is similar to *L. desultor* but is smaller, with females dark-colored and having annulated legs. The male palp has a basally wider tibial apophysis (fig. 16; cf. Platnick and Sedgwick, 1984: fig. 47); the tegular process is blunt and basally wider, the retrodorsal corner of the tegular ledge is less protruding (figs. 18, 19; cf. 22–24); the paraembolic plate is triangular and the embolus shorter, with the median longitudinal ridge on its sclerotized part indistinct (figs. 16, 17; cf. figs. 26, 27). The female poreplate is cross-oval in shape, with the anterior margin procurved (figs. 20, 21; cf. fig. 28).

MALE (holotype): Sclerotized parts mostly brown (dark brown when alive), on ventral side generally lighter, palpal tarsi darkest; proximal portion of chelicerae cream; hindmargin of carapace and of posterior abdominal tergites with orange markings; membranous abdomen light gray-brown. Total length 20.9. Carapace 8.6 long, 8.0 wide, covered by several short black hairs. Ocular tubercle 1.19 long, 1.50 wide. Eye sizes and interdistances: AME 0.09, ALE 0.85, PME 0.52, PLE 0.69; AME-AME 0.11, AME-ALE 0.15, PME-PME 0.06, PME-PLE 0.08, ALE-

PLE 0.07. MOQ length 0.67, front width 0.31, back width 0.85. Sternum 3.3 long, 2.8 wide (1.3 on ventral surface). Labium 0.8 long, 1.6 wide. Palpal coxae 2.8 long, 1.8 wide. Cheliceral promargin with 11/11 small teeth. Superior tarsal claws with 3–4 (mostly 3) teeth, unpaired claw with 1–2 denticles on legs I–III, none on leg IV. Leg and palp measurements:

	I	II	III	IV	Palp
Femur	7.1	7.3	7.6	9.2	4.4
Patella	3.6	3.7	3.8	3.9	2.7
Tibia	5.3	5.7	6.1	7.7	4.7
Metatarsus	6.0	6.9	8.9	11.9	—
Tarsus	2.6	2.8	3.3	4.6	2.3
Total	24.6	26.4	29.7	37.3	14.1

Abdomen 8.9 long, 6.5 wide, covered by short black hairs. Palp with conical tibial apophysis bearing four long, tapering terminal spines. Cumulus only slightly elevated, carrying 3–4 long spines (figs. 15, 16); dorsal patch of spicules on paracymbium proximally bordered by indistinct pale band (fig. 14). Subtegular apophysis absent. Tegulum with short, blunt, basally wide process; retrodorsal corner of tegular ledge protruding only slightly (figs. 18, 19); contrategulum with sigmoid row of erect teeth along proximal edge, distal edge slightly arched (fig. 14). Distal sclerite of palpal organ with pale zone at base of triangular, distally rounded paraembolic plate; embolic parts detached, sclerotized part strengthened by three longitudinal ridges, median ridge discernible only in distal zone (figs. 15–17).

FEMALE (allotype): As in male, except for the following: carapace and distal chelicerae brown (dark when alive), with dark w-shaped marking between eyes and fovea; dark lateral patches on posterior abdominal tergites and dark lateral plus median patches on anterior tergites separated by light orange markings. Proximal leg and palp segments brown (except for predominantly light femora of anterior legs and palps), distal ones dark brown; broad, light orange bands on median femora, tibiae, and metatarsi, light distal bands on patellae and tibiae; proximal chelicerae light orange. Total length 22.4. Carapace 8.2 long, 7.4 wide. Ocular tubercle

1.07 long, 1.25 wide. Eye sizes and interdistances: AME 0.11, ALE 0.75, PME 0.44, PLE 0.58; AME-AME 0.11, AME-ALE 0.09, PME-PME 0.05, PME-PLE 0.06, ALE-PLE 0.08. MOQ length 0.59, front width 0.31, back width 0.75. Sternum 3.9 long, 2.8 wide (1.4 on ventral surface). Labium 0.9 long, 1.9 wide. Palpal coxae 2.9 long, 1.9 wide. Cheliceral promargin with 12/13 teeth. Superior tarsal claws with 2–3 teeth, unpaired claw with 2–3 denticles on legs I–III, 0–1 on leg IV; palpal claw with 2/2 denticles. Leg and palp measurements:

	I	II	III	IV	Palp
Femur	5.4	5.4	5.5	7.1	4.5
Patella	3.2	3.2	3.2	3.6	2.8
Tibia	3.7	3.7	4.0	5.4	3.5
Metatarsus	3.4	3.8	4.5	7.1	—
Tarsus	1.6	1.8	2.1	3.1	3.3
Total	17.3	17.9	19.3	26.3	14.1

Abdomen 10.3 long, 8.7 wide. Vulva (figs. 20, 21) with cross-oval poreplate; weak lobes indicated by anterolateral swellings on marginal lip (ledge); anterior margin slightly arched. Ventral pores and racemose receptacular cluster distinctly elevated. Posterior stalk not sharply outlined against sclerotized part of genital atrium; hind-margin more or less straight. No hairs in genital atrium.

OTHER MATERIAL EXAMINED: A penultimate male collected at the type locality (Feb. 5, 1991; P. Schwendinger).

VARIATION: Measurements of carapace length/width range: males 8.1–8.6/7.5–8.0 (n = 2), females 7.3–8.2/6.5–7.4 (n = 2). The smaller female and the penultimate male have a light brown carapace coated by a pattern of dark brown spots.

DISTRIBUTION: Known only from high altitudes of Bukit Larut (4°52'N, 100°48'E), a mountain overlooking the city of Taiping.

NATURAL HISTORY: The spiders were collected from earth banks and rocks along a road through montane rainforest. The mountain receives a mean annual precipitation of slightly more than 5000 mm and is the wettest place in peninsular Malaysia. Accordingly, all *Liphistius* (and also other trapdoor spiders) found had their abdomens coated with droplets of condensed water.

Burrows, up to 13 cm long, were unbranched with a single trapdoor (mostly those of large females) or T-shaped with 2 doors (for several juveniles); two immature males were collected from saclike webs attached to rocks. Trapdoors were up to 2.2 cm long and 3.1 cm wide for females (for males up to 2.3 and 3.4 cm, respectively); if a second door was present (without signal threads), it was smaller than the main door. From the entrance, 5–8 signal threads, up to 12 cm long, were spread over the soil or rock surface.

A globular egg case, 2.6 cm in diameter, 1.6 cm high, collected at the beginning of February contained 110 dark yellow eggs (diameter range 1.44–1.62, n = 10) in an early embryonic stage. Eggs were lying on the floor of the egg chamber; no suspension threads were seen. The female collected with an egg case molted in mid-April. In captivity, males matured in August, which probably accords with the mating period in nature. Oviposition presumably takes place at the end of the year.

Liphistius desultor Schiödte

Figures 22–28

Lipistius desultor Schiödte, 1849: 621, figs. 1–7.
— Roewer, 1942: 145.

Liphistius mammillanus O. P.-Cambridge, 1875: 249, figs. 1–3. First synonymized by Hasselt, 1880: 186.

Liphistius batuensis (misidentification): Kraus, 1978: 237, figs. 2–4.

Liphistius desultor: Hasselt, 1880: 186. — Brystowe, 1932: 1025, figs. 1, 5a, 7b, 8a, pl. 1, pl. 2, figs. 1, 2, 4. — Bonnet, 1957: 2548. — Brystowe, 1976: 2, figs. 2, 4. — Yong, 1978: 32, photos 1–9. — Murphy and Platnick, 1981: 51, figs. 1–6, 22, 23. — Haupt, 1983: 279, figs. 5a, 6a. — Platnick and Sedgwick, 1984: 18, figs. 45–51.

RELATIONSHIPS: *Liphistius laruticus*, new species, and *L. desultor* are a close species pair related to the *trang*-group (Schwendinger, 1990: 349) in southern Thailand, i.e.: *L. rufipes* Schwendinger (also found in northern Malaysia), *L. thaleban* Schwendinger, *L. bicoloripes* Ono, *L. castaneus* Schwendinger, *L. niphanae* Ono, and *L. trang* Platnick and Sedgwick. *Liphistius kanthan*, new species, *L. yangae* Platnick and Sedgwick (in both, males unknown), *L. langkawi* Platnick and

Sedgwick, and *L. murphyorum* Platnick and Sedgwick show similar types of female and male genitalia and can be associated with the *trang*-group as well. *Liphistius tempurung*, new species, *L. endau* Sedgwick and Platnick, *L. johore* Platnick and Sedgwick (in all three, males unknown), *L. malayanus* Abraham, *L. batuensis* Abraham, *L. panching* Platnick and Sedgwick, and *L. tioman* Platnick and Sedgwick, on the other hand, possess fairly different types of poreplates and embolic sclerites and should be placed in a separate species group when revised.

VARIATION: Measurements of carapace length/width are: males 9.8–10.7/7.2–8.2 (n = 4), female 14.1/13.5. The male from Maxwell Hill shows a more pronounced pattern of dark brown and orange markings on the abdominal tergites; its left palpal organ has a basally wider tegular process (fig. 25) than does its right palp (fig. 24) or those of the other males examined (figs. 22, 23). The male from Kedah Peak possesses a less smoothly rounded paraembolic plate than others (fig. 27). The spines on cumulus vary in number from four to six. The poreplate of the female examined shows thicker lateral lips (fig. 28) than in females previously illustrated. Its anterior poreplate margin is slightly indented, as in the holotype (Haupt, 1983: figs. 5a, 6a), whereas in two other females it is straight (Murphy and Platnick, 1981: figs. 22, 23; Platnick and Sedgwick, 1984: figs. 50, 51).

MATERIAL EXAMINED (all specimens collected by P. Schwendinger, deposited in MHNG): **MALAYSIA: Kedah:** Kedah Peak (= Gunung Jerai), Gurun, Sungai Petani, elev. 170 m, 1♂ (molted Apr. 10, June 30, 1995, matured Oct. 26, 1995), elev. 950 m, 1 penultimate ♂, both collected Feb. 1, 1995.

Penang: Penang Hill, Penang Island (= Pulau Pinang), elev. 700 m, 1♂ (molted May 3, 1992, matured Aug. 23, 1992), elev. 580 m, 1♂ (molted May 27, 1992, matured Sept. 24, 1992), elev. 680 m, 1♀ (molted May 27, 1992), all collected Dec. 1, 1991. **Perak:** Maxwell Hill (= Bukit Larut), Taiping, elev. 50 m, 1♂ (molted July 19, 1996, matured Oct. 10, 1996) and 1 penultimate ♂, both collected Jan. 1, 1996; elev. 440 m, 1 penultimate ♂ (Jan. 24, 1995).

DISTRIBUTION: Known from Penang Island

(type locality; 5°27'N, 100°16'E) and from two nearby localities on the mainland of West-Malaysia: Kedah Peak (5°49'N, 100°26'E) and Maxwell Hill (4°52'N, 100°46'E).

NATURAL HISTORY: All specimens were collected on road sides in rainforest, at elevations between 50 and 950 m. Some spiders lived in dry sandy soil at places fully exposed to the mid-day sun. This ability to survive in fairly dry habitats may account for their relatively (for *Liphistius*) wide distribution.

Burrows were up to 33 cm long, usually unbranched, closed with a single trapdoor; only one medium-sized female from Maxwell Hill had a saclike web. The trapdoors,

usually thick and rigid, were up to 4.1 cm long and 6.1 cm wide (for males up to 2.8 and 4.0 cm, respectively), hinged on the upper margin. From the entrance, 6–8 (in one female from Maxwell Hill even 9!) signal threads were spread over the soil surface.

At the beginning of December, a large female from Penang Hill was collected sitting on a 4.3 cm wide, 3.9 cm long, and 2.8 cm high globular egg case with walls up to 0.9 cm thick. It contained 509 dark yellow eggs (diameter range 1.68–1.84, n = 20) without suspension threads discernible. The female subsequently molted in late May. Males in captivity matured between late August and late October (probably the period when mating takes place in nature; oviposition is presumably in November).

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